TESTING THE STATIONARITY OF BETA FOR AUTOMOTIVE AND AUTO-ANCILLARY SECTOR STOCKS IN INDIAN STOCK MARKET

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Introduction

The Capital Asset Pricing Model is the original model of capital market equilibrium, expressing the expected return of any asset as a function of three quantities only: the asset's beta (the rate of change of asset return with respect to market return), the risk-free rate, and the expected market return. Mathematically:

$$E(r) = r_f + [E(r_M) - r_f].\beta(r), \quad (1)$$

where β is the asset's beta, r_f is the risk-free rate, and $E(r_M)$ is the expected market return.

This implies that an asset's responsiveness to general market movements is the only variable to cause systematic differences in return between assets.

Beta is also referred to as the systematic risk, as it measures the sensitivity of the asset's returns to market returns or equivalently, the asset's volatility in relation to that of the market. By definition, the market has a beta of unity, and individual stocks are ranked according to how much they deviate from the market. A stock that fluctuates more than the market over time has a beta greater than unity, while a stock that fluctuates less than the market has a beta less than unity. High-beta stocks are expected to be riskier, but provide a potential for higher returns; low-beta stocks pose less risk, but yield lower returns. Also, an asset has a beta of zero if its returns are unrelated to market returns; a positive beta means that the asset's returns are positively correlated with market returns, with both tending to be above or below their respective averages together; and a negative beta means that the asset's returns are negatively correlated with market returns, so that one tends to be above its average when the other is below its average. Beta is usually estimated using regression analysis of asset returns against market returns.

Beta is often used via the CAPM to estimate the cost of capital, which represents the discount rate used to calculate the present value of a company's future cash flows. Ceteris paribus, the higher company's beta is the higher cost of capital/discount rate, and in turn the lower the present value of its future cash flows. Thus, beta can impact a company's valuation.

Literature Review

The temporal behavior of beta is a widely-studied area in the asset pricing literature. Stationarity of beta examines fluctuations in beta in different periods, while stability of beta studies the fluctuations in beta due to the choice of returns calculation interval (Gooding and O'Malley, 1977).

Blume (1971) found that asset betas for individual securities were poor estimates of betas in subsequent periods, and that the correlation between periods increased with portfolio size. Similar results were obtained by Levy (1971), Levitz (1974), and Altman et al. (1974). Blume (1975) identified a mean reversion tendency of betas. Scott and Brown (1980) suggested that the instability of beta resulted on account of concurrent auto-correlated residuals and inter-temporal correlation between market returns and residuals.

Several studies have examined the impact of changes in market conditions on beta stationarity, including quite a few studies in Indian stock markets. Fabozzi and Francis (1977) found that there was no significant impact of alternating bull and bear markets on beta, using a modified version of the single index model, the dual beta market model. On the other hand, Gooding and O'Malley (1977) found that beta coefficients were significantly influenced by major market trends. Garbade and Rentzler (1981) tested beta stationarity using a variable parameter regression, compared with a random coefficients model, as proposed by Fabozzi and Francis (1977). Gupta and Mallick (1996) found year-to-year variation in beta among stocks on the Bombay Stock Exchange, and further found that this variation could not be explained by any accounting information. Chawla (2001) found evidence against the stationarity of beta for a considerable percentage of stocks in Indian stock markets using regression with slope dummy variables. Moonis and Shah (2002) examined the time-varying beta through two approaches: the Kalman filter, and the bivariate GARCH model. They found evidence against beta stationarity for a considerable percentage of stocks. Chawla (2003) found evidence for non-stationarity of alpha, but only limited evidence of non-stationarity of beta over bull and bear phases in Indian stock markets. Singh (2007) found considerable variation in the value of beta, and its stationarity and stability, depending on the computational method used.

Beta is the central concept in the CAPM model. If betas vary considerably across time, the CAPM model's explanatory power would be undermined. The objective of the study is to test the stationarity of beta for automotive and auto-ancillary sector stocks in different market regimes in Indian stock markets.

Methodology

The study was performed using a sample of eleven automotive and auto-ancillary stocks traded on the Bombay Stock Exchange (BSE), India, including: Amtek Auto Ltd., Apollo Tyres Ltd., Ashok Leyland Ltd., Bajaj Auto Ltd., Bharat Forge Ltd., Cummins India Ltd., Exide Industries Ltd., Hero Honda Motors Ltd., Mahindra & Mahindra Ltd., Maruti Suzuki India Ltd., Tata Motors Ltd. The data for the study consisted of the closing stock prices as well as the closing BSE Sensex index prices in the study period. The data was collected from the BSE website.

The study period considered was Apr. 1, 2001- Mar. 31, 2011. This was subdivided into five sub-periods, by identifying macroeconomic and market trends (Nagaraj, 2013). The following sub-periods were used to test the stability:

- Period 1 (Stagnant phase): Apr. 2001 - Mar. 2003. This period can be described as a stagnant phase, as the economy was stable.
- Period 2 (Growth phase): Apr. 2003 - Mar. 2005. This period can be referred as a "growth" phase as the market was just beginning to pick up from the steady phase.

Here the economy was beginning to realize the potential and hence there was a sudden growth.

- Period 3 (Boom phase): Apr. 2005 - Dec. 2007. This period can be referred to as a "boom" phase. Here the growth was at its peak. It was a rapid growth phase and the best for the economy and market.
- Period 4 (Depression phase): Jan. 2008 - Mar. 2009. The market was showing the impact of downturn and this was the year when the market was hit by global recession. So it can be referred as "depression" phase.
- Period 5 (Steady phase): Apr. 2009 - Mar. 2011. This was the phase when market was recovering from the depression. This period is also called as the "steady" phase.

The monthly returns of each stock as well as of the index were calculated using the usual log-returns formula: $r_t = \ln (S_t/S_{t-1})$. The beta and alpha represent the slope and intercept, respectively, of the regression of each stock return on index returns. The beta of each stock was calculated using the regression slope formula:

$$\beta(r) = \frac{COV(r_t, r_{Mt})}{V(r_{Mt})}, \tag{2}$$

where r_t is the rate of return of the asset and r_{Mt} is the rate of return of the market portfolio, and the alpha of each stock was calculated by using the formula: $\alpha(r) = \bar{r} - \beta(r).\overline{r_M}$. This was performed for each time period separately, as well as overall.

In order to test the stability of beta across the time periods, univariate ANCOVA/General Linear Model was performed taking each stock return as the dependant variable, the period as the fixed factor, and index returns as the covariate. The null hypothesis for the study is that betas are relatively constant across time periods and in different market regimes.

Findings

The alphas of the sample stocks across the different periods are presented in Table 1.

Table 1. Alphas of Automotive Stocks across Periods

Stock	Period 1	Period 2	Period 3	Period 4	Period 5	Overall
Amtek Auto Ltd.	0.0139	-0.0319	-0.0047	-0.0389	-0.0155	-0.0043
Apollo Tyres Ltd.	-0.0012	-0.0065	-0.1176	-0.0124	0.0190	-0.0162
Ashok Leyland Ltd.	0.0006	-0.1140	-0.0108	-0.0070	0.0113	-0.0166
Bajaj Auto Ltd.	-	-	-	0.0384	0.0118	0.0225
Bharat Forge Ltd.	0.0109	0.0363	-0.0766	-0.0139	0.0122	-0.0047
Cummins India Ltd.	-0.0206	0.0045	0.0131	-0.0045	0.0382	-0.0040
Exide Industries Ltd.	0.0069	-0.0167	-0.0235	0.0070	0.0203	-0.0020
Hero Honda Motors Ltd.	0.0002	0.0141	-0.0143	0.0585	-0.0036	0.0012
Mahindra & Mahindra Ltd.	-0.0073	0.0281	0.0068	0.0057	0.0007	-0.0044
Maruti Suzuki India Ltd.	-	0.0055	-0.0131	0.0060	-0.0081	0.0050
Tata Motors Ltd.	-0.0094	0.0018	-0.0220	-0.0062	0.0374	-0.0081

None of the sample stocks was found to have statistically significant overall mean alpha. Further, eight (80.0%) of the sample stocks were found to have negative alphas in Period 3 (Boom phase), while five (55.6%) and eight (72.7%) of the sample stocks were found to have positive alphas in Period 1 (Stagnant phase) and Period 5 (Steady phase), respectively. Overall, eight (72.7%) of the sample stocks were found to have negative mean alphas.

The betas of the sample stocks across the different periods are presented in Table 2.

Table 2. Betas of Automotive Stocks across Periods

Stock	Period 1	Period 2	Period 3	Period 4	Period 5	Overall
Amtek Auto Ltd.	0.6180	0.8445	0.9201	1.5326	1.7138	0.9984**
Apollo Tyres Ltd.	1.1616	1.3442	1.8039	1.2491	1.3262	1.2218**
Ashok Leyland Ltd.	1.3539	1.7435	0.9690	1.3465	1.1803	1.2677**
Bajaj Auto Ltd.	-	-	-	0.8631	1.0253	0.8958**
Bharat Forge Ltd.	1.0554	1.0163	0.9670	1.4240	1.3849	1.1127**
Cummins India Ltd.	0.6433	0.7692	0.7359	1.1241	0.6270	0.8166**
Exide Industries Ltd.	0.7375	1.0118	0.1053	0.8269	1.0531	0.7066**
Hero Honda Motors Ltd.	1.3775	0.7767	0.6551	0.7071	0.8252	0.9586**
Mahindra & Mahindra Ltd.	1.3220	0.9689	0.3756	1.1496	0.7886	1.0757**
Maruti Suzuki India Ltd.	-	1.4364	1.0978	0.5028	1.2320	0.9223**
Tata Motors Ltd.	1.5081	1.3141	1.0837	1.7699	1.3954	1.4774**

All of the sample stocks were found to have statistically significant and positive overall mean betas, and five (45.5%) of the sample stocks were found to have an overall mean beta greater than unity. Further, six (60.0%) of the sample stocks had higher average beta in Periods 4 & 5 as compared to Periods 1, 2, & 3 (i.e. during and after the global financial crisis vs. prior to the crisis). Also, seven (63.6%) of the sample stocks had variability (coefficient of variation) in excess of 20%.

The results of the univariate ANCOVA tests for stability of betas across the different periods for each of the sample stocks are presented in Table 3.

Table 3. Univariate ANCOVA Tests

Stock	Corrected model	Intercept (α)	BSE (β)	Period
Amtek Auto Ltd.	5.902**	0.975	24.763**	0.644
Apollo Tyres Ltd.	8.495**	1.065	37.611**	1.494
Ashok Leyland Ltd.	8.340**	1.725	37.675**	1.120
Bajaj Auto Ltd.	3.932*	0.686	7.720**	0.153
Bharat Forge Ltd.	10.791**	0.378	44.805**	2.242
Cummins India Ltd.	6.911**	0.046	25.424**	0.747
Exide Industries Ltd.	3.049	0.041	13.569**	0.557
Hero Honda Motors Ltd.	9.050**	0.333	43.439**	1.040
Mahindra & Mahindra Ltd.	14.977**	0.009	67.480**	0.430
Maruti Suzuki India Ltd.	17.070**	0.587	64.919**	0.582
Tata Motors Ltd.	54.938**	0.550	245.981**	2.069

The beta and overall corrected model were found to have significant for all of the sample stocks, and the alpha was found to be not statistically significant for all of the sample stocks. The period was found to be not statistically significant for all of the sample stocks, i.e. the betas were stationary across the periods.

Discussion

The results of the study support the hypothesis of beta stationarity for automotive stocks in Indian stock markets. Thus, historical betas may provide reliable estimates of stock betas for use in financial analysis, especially valuation analysis.

The results of the study also indicate that most automotive and auto-ancillary sector stocks have negative alphas in the Boom phase and overall, and positive alphas in the Stagnant and Steady phases, though not statistically significant. Thus, in risk-adjusted terms, automotive and auto-ancillary sector stocks seem to marginally under-perform in bull periods and marginally over-perform in stagnant periods.

The results of the study also indicate that about 50% of automotive and auto-ancillary sector stocks have betas greater than unity, and 50% of them have betas less than unity; with a shift towards betas greater than unity in the Stagnant and Steady phases, and towards betas less than unity in the Boom phase. Thus, there was mixed movement of automotive and auto-ancillary sector stocks vis-à-vis the market as a whole, with some tendency to be more volatile than the market in the Stagnant and Steady phases. Overall, this suggests that automotive and auto-ancillary sector stocks yield higher returns to investors in bear and stagnant periods, but may be riskier in bull periods. Thus, automotive and auto-ancillary sector stocks may be more suitable for speculators than for long-term investors.

There are some limitations inherent in the present study. The study considers a small sample of automotive and auto-ancillary sector stocks for the analysis, most of which are large-cap stocks. Also, the study period selected was relatively short, only ten years. The results of the study may be specific to the study period considered, particularly due to the adverse impact of the global financial crisis. Also, though the sub-periods considered in the study were generally in accordance with the literature, there is a degree of ambiguity in the identification of structural breaks in stock market trends, and the results may be sensitive to the choice of sub-periods. The analysis should be further corroborated with other methods such as dummy variable regression and the Chow test. Also, the analysis should be performed for other sectors to assess the stationarity of beta in general. Further, stationarity should be investigated for extensions of the market model such as the Fama-French three-factor model and other multi-factor models.

References

Altman, E.I., Jacquillat, B. and Levasseur, M. (1974), "Comparative Analysis of Risk Measures: France and the United States", *Journal of Finance*, Vol. 29 No. 5, pp. 1495-1511.

Blume, M.E. (1971), "On the Assessment of Risk", *Journal of Finance*, Vol. 26, pp. 1-10.

Blume, M.E. (1975), "Betas and Their Regression Tendencies", *Journal of Finance*, Vol. 30, pp. 785-795.

Chawla, D. (2001), "Testing Stability of Beta in the Indian Stock Market", *Decision*, Vol. 28 No. 2, pp. 1-22.

Chawla, D. (2003), **"**Stability of Alphas and Betas over Bull and Bear Markets: An Empirical Examination", *Vision: The Journal of Business Perspective*, Vol. 7, pp. 57-77.

Fabozzi, F.J. and Francis, J. C. (1977), "Stability tests for alphas and betas over bull

and bear market conditions", *Journal of Finance*, Vol. 32, pp. 1093-1099.
Garbade, K. and Rentzler, J. (1981), "Testing the Hypothesis of Beta Stationarity", *International Economic Review*, Vol. 22 No. 3, pp. 577-587.
Gaur, J. and Dash, M. (2015), "Macroeconomic Factors and Performance of Indian Stock Market", *Journal of Applied Management and Investments*, Vol. 4 No. 1, pp. 11-15.
Gooding, A.R. and O'Malley, T.P. (1977), "Market Phase and the Stationarity of Beta", *Journal of Financial and Quantitative Analysis*, Vol. 12 No. 5, pp. 833-857.
Gupta, A. and Mallick, A.K. (1996), "Interrelation between Market-Based Security Risk Measure and Accounting Information: A Study on Selected Indian Companies", *Decision*, Vol. 23, pp. 1-24.
Levitz, G.D. (1974), "Market Risk and the Management of Institutional Equity Portfolios", *Financial Analysts Journal*, Vol. 30 No. 1, pp. 53-60.
Levy, R.L. (1971), "On the Short-Term Stationarity of Beta Coefficients", *Financial Analysts Journal*, Vol. 27 No. 6, pp. 55-62.
Moonis, S.A. and Shah, A. (2002), "Testing for time variation in beta in India", *Journal of Emerging Markets and Finance*, Vol. 2 No. 2, pp. 163-180.
Nagaraj, R. (2013), "India's Dream Run, 2003-08", *Economic and Political Weekly*, Vol. 48 No. 20, pp. 39-51.
Scott, E. and Brown, S. (1980), "Biased Estimators and Unstable Betas", *Journal of Finance*, Vol. 25 No. 1, pp. 49-55.
Singh, R. (2008), "Beta Estimation in the Indian Stock Market: Stability, Stationarity and Computational Considerations", *Decision*, Vol. 35 No. 2, pp. 63-85.

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Abstract

Beta is the central concept in the CAPM model. If betas vary considerably across time, the CAPM model's explanatory power would be undermined. The objective of the study is to test the stationarity of beta for automotive and auto-ancillary sector stocks in different market regimes in Indian stock markets. The study was performed using a sample of eleven automotive and auto-ancillary sector stocks listed on the Bombay Stock Exchange, India, over a study period of 10 years. The study period was sub-divided into phases based on overall market trends: Stagnant phase (Apr. 2001 - Mar. 2003), Growth phase (Apr. 2003 - Mar. 2005), Boom phase (Apr. 2005 - Dec. 2007), Depression phase (Jan. 2008 - Mar. 2009), and Steady phase (Apr. 2009 - Mar. 2011). The analysis was performed through the application of univariate ANCOVA.

The results indicate that the betas were relatively stationary over the different market regimes for all of the sample stocks. This suggests that beta can be taken to be stationary for automotive and auto-ancillary sector stocks in Indian stock markets.

Keywords: time-varying beta, automotive and auto-ancillary sector, Indian stock market, univariate ANCOVA